TABLE 4. ATTENUATION AT DUCT BRANCHES OR OUTLETS

RATIO $\frac{\text{Branch Duct + Outlet Area}}{\text{Supply Duct Area}}$ OR $\frac{\text{Sum of Branch Areas}}{\text{Supply Duct Area}}$	ATTENUATION PER TRANSFORMATION, db
1.00	0.0
1.20	0.8
1.35	1.3
1.50	1.8
1.75	2.5
2.00	3.0

(4) low moisture absorption, (5) freedom from attack by bacteria and algae, (6) low surface coefficient of friction, (7) particles should not fray off at the higher design velocities, and (8) odor free when either dry or wet.

For each absorber discussed an attenuation equation or table is given which will give results as accurate as predictable under the present status of engineering knowledge. With every application the use of sound absorptive material should be considered in the dual function of insulation and sound absorption. It has been shown theoretically[5] that the reduction, in decibels per linear foot, of sound transmitted through a duct lined with sound absorbing material is related in a rather complicated manner to the size and shape of the duct, to the frequency of the sound, and to the sound absorbing characteristics of the lining. Experimental evidence likewise indicates that there is no simple formula involving the variables which will apply accurately to all cases.

TABLE 5. APPROXIMATE ATTENUATION BETWEEN GRILLES AND ROOM

OUTLET VELOCITY FPM	AIR CHANGE MIN.	LIVE ROOM[b] $a^a = 0.05$ db	MEDIUM ROOM[c] $a = 0.15$ db	DEAD ROOM[d] $a = 0.25$ db
500	5	11	16	18
	10	14	19	21
	15	16	21	23
	20	17	22	24
750	5	13	18	20
	10	16	21	23
	15	18	23	25
	20	19	24	26
1000	5	14	19	21
	10	17	22	24
	15	19	24	26
	20	20	25	28
1250	5	15	20	22
	10	18	23	25
	15	20	25	27
	20	21	26	28

[a]Average absorption coefficient for the room.
[b]Live room average absorption coefficient 0.05. Bare wood or concrete floor—hard plaster walls and ceiling—minimum of furniture.
[c]Medium room average absorption coefficient 0.15. Carpeted floor, upholstered furniture, hard plaster walls and ceiling or bare room with acoustically treated ceiling.
[d]Dead room average absorption coefficient 0.25. Heavy carpeted floor. Walls and ceiling acoustically treated. Upholstered furniture.

[5]Sound Propagation in Ducts Lined with Absorbing Materials, by L. J. Sivian (*Journal Acoustical Society of America*, Vol. 9, p. 1937).

The noise reduction varies to a considerable extent with the frequency of the sound. In calculating noise reduction, consideration should be given both to the comparative efficiency of the duct lining material at different frequencies, and to the frequency distribution of the noise to be quieted. In the case of fan noise, it is recommended that calculations be based on the frequency 256 cycles, since most of the noise energy is in the region of this frequency. In quieting noise due to air turbulence and eddy currents, in which the high frequencies predominate, the frequency 1024 cycles should be used.

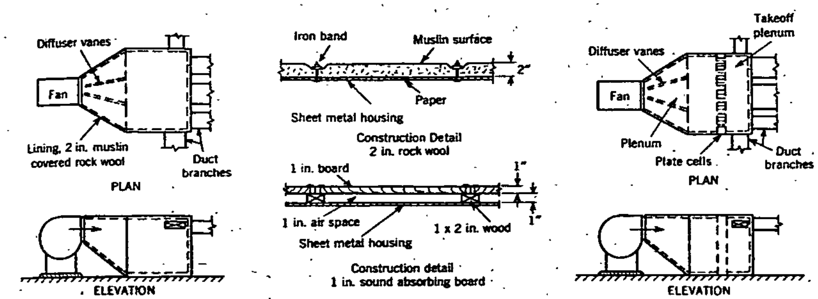

FIG. 1. ABSORPTION PLENUMS WITH AND WITHOUT SOUND CELLS

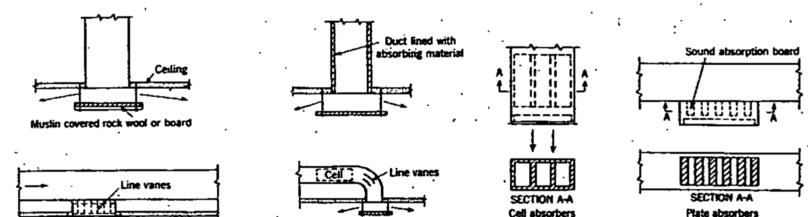

FIG. 2. OUTLET CELLS FOR PAN OUTLETS OR GRILLES

Plenum Absorption

In systems, where individual ducts are directed to a number of rooms and sound treatment is required in every duct, a sound absorption plenum on the fan discharge as shown in Fig. 1, will often prove the most economical arrangement. The absorption in the plenum may be approximated by Equation 5.

$$db \text{ (attenuation)} = 10 \log_{10} \frac{\text{Plenum Absorption in Sabines}}{\text{Area Fan Discharge}} \quad (5)$$

The area of the plenum should be at least ten times as great as the fan discharge area. The plenum should be lined with 2 in. of muslin covered